

NATIONAL GEOGRAPHIC

Designing the Perfect Pet

Can a fox become man's best friend?

A New Geologic Epoch:
The Age of Man 60

Living Fossil Fish 86

Battle of the Kung Fu Masters 94

Pollinators: Birds, Bees...Lemurs? 114

Circling Alaska in 176 Days 132

POSTER: Who Is Earth's Most Typical Human?



MORE >

NATIONAL GEOGRAPHIC

VOL. 219 • NO. 3

March 2011

Cover Story

Taming the Wild

A dog isn't the only animal that can be man's best friend. All it takes is the right genes.

OFFICIAL JOURNAL OF THE
NATIONAL GEOGRAPHIC SOCIETY



Enter the Age of Man

We remove mountains, raise supercities, transform our planet.

Ancient Swimmers

Fish that date to dinosaur days get rare human visitors.



Kung Fu Kingdom

The changing world of martial arts.

[VIDEO](#)



MORE



Gold Dusters

Pollinators deserve a closer look.

VIDEO



Alaska Trek

What makes a world-class hiker cry?
Ask Andrew Skurka.



March 2011 | Departments



Editor's Note

Nat Geo Channel

Letters

Your Shot

SLIDE SHOW

Visions of Earth

—

Explorers Journal

Inside Geographic

Flashback

Next Month

On the Cover

Wild foxes in Ontario's Algonquin Provincial Park are so used to people that they beg for food—and sometimes pose for a portrait.

Photo by Greg Schneider

POPULATION

How Big Is Seven Billion?

Figuring it out in other terms, from footsteps to text messages.

VIDEO

TECHNOLOGY

Solar Magellan

A European crew aims to sail around the world in a sun-powered ship.

HISTORY

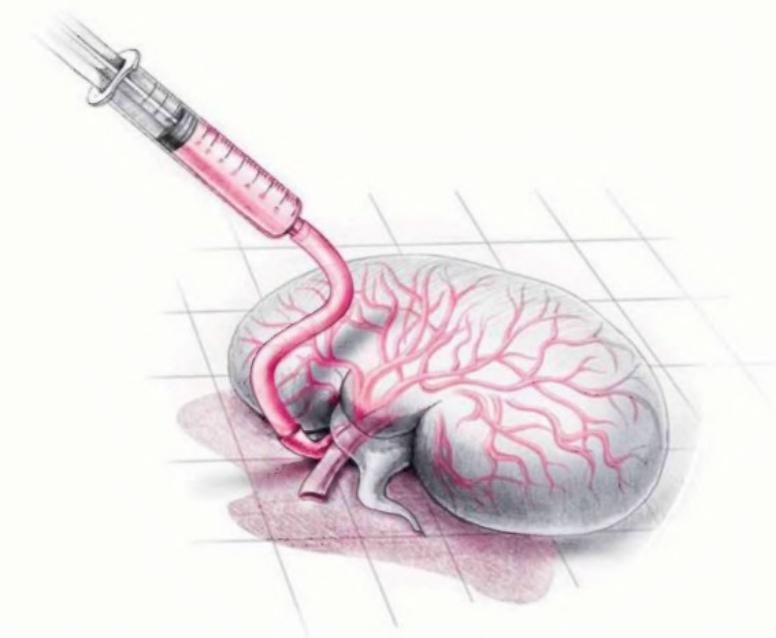
Peace Corps Rising

On the service group's golden anniversary, enlistment is up.

SPACE

Lunar Probe

Bouncing laser beams have mapped the moon's pocked surface.



CONSERVATION **In the Pink**

Bolivians save 20 trapped pink river dolphins.

CONSERVATION **Elephants at Risk**

Trains are colliding with protected pachyderms in India.

THE BIG IDEA

Grow Your Own Organs -----

One day, people may send cells to a lab to order new body parts.

eEXTRAS

Seven Billion Interactive Special Report: Egypt

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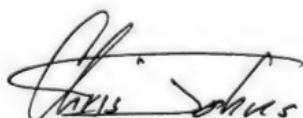
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EDITOR'S NOTE

In Jackson's mind there is no such thing as a good person or a bad person. There are only people he desperately wants to meet. Jackson, I should explain, is my Jack Russell terrier. When he meets someone, his short tail wags at warp speed, sending a vibration through his piebald body right up to his floppy ears. He is exuberant, playful, affectionate—everything a dog lover could wish for. He fits the description of an animal domesticated through years of selective breeding.

In this month's issue we explore animal domestication, which began more than 15,000 years ago with dogs. As humans bred wolves to be our hunting companions and friends, changes in appearance occurred along with changes in behavior. Traits that might otherwise have been weeded out in the wild survived because they were, well, cute. Jackson, with his piebald coloring and floppy ears, is a classic example. But I think there is more to it than that. When my family went shopping for a dog, Jackson confidently trotted over and made it clear he liked us. We immediately responded by picking him up and hugging him. I have to wonder if there is something in human genes that makes our response to a puppy so immediate and positive. Are we genetically predisposed to connect with dogs? Can a case be made that dog lovers had a better chance of survival with the help of man's best friend—in a violent and uncertain world—to put food on the table and guard against threats? It makes sense to me, but cat lovers may not buy my theory.

A handwritten signature in black ink, appearing to read "Chris Jones".



Jackson the Jack
Russell terrier extends
a friendly paw.

PHOTO: REBECCA HALE, NGM STAFF

NAT GEO CHANNEL



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CHANNEL

Hard Time
Tuesdays at 10 p.m.

Get to know the inmates
of an Ohio state prison.



Wild
Moho
Investigates

For a full schedule of listings go to natgeotv.com.



THIS MONTH

Beast Hunter

Once upon a time, mountain gorillas and giant pandas were considered mythological creatures. Do other seemingly folkloric animals actually live and breathe in the wild? Biologist and explorer Pat Spain aims to find out. Follow his quest to separate fiction from fact in *Beast Hunter*, as he uses the latest technology to track down species thought to exist only in our imaginations. He's a trained scientist, but Spain's most powerful assets on this journey might just be his enthusiasm and inquisitive mind. Don't miss *Beast Hunter*, premiering March 4 at 9 p.m. and then every Friday at 9 p.m. on the National Geographic Channel.

In Cameroon (left) a Pygmy shaman applies ceremonial dye to "beast hunter" Pat Spain before a hunt.

NAT GEO
WILD

Case Files

days at 8 p.m.

Investigate Earth's most
king natural events.

PHOTOS: ANDREW BAKER (BOTTOM LEFT); INSTITUTE
FOR MARINE MAMMAL STUDIES (BOTTOM RIGHT)

VISIONS OF EARTH

United Kingdom On the
Piles of powder and extr



banks of Loch Tulla in the Scottish Highlands, trees emerge during a snowstorm. Extreme cold made last winter one of the region's harshest in decades.

PHOTO: BILLY CURRIE PHOTOGRAPHY/GETTY IMAGES





Spain A late afternoon stroll in Barcelona becomes a study in black and white.

March. Temperatures in the city, on the Mediterranean coast, usually fall bet-



ite during a rare snow shower last
ween 50° and 60°F this time of year.

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TECHNOLOGY

Solar Magellan? A month into their quest to be the first to circle the world in a sun-powered ship, the European crew of the *Tûranor PlanetSolar* drew the curiosity of some locals in the Atlantic Ocean. "We stayed next to four magnificent sperm whales for nearly 20 minutes," says the ship's master, Patrick Marchesseau. "They seemed completely at ease with the silent visitor."

That visitor was a 95-ton catamaran that had embarked in September on a journey expected to last about eight months. The \$17.5-million craft can hit up to 12 knots and aims to show the potential of clean-energy travel. Yet some seafaring traditions die hard: With the first crossing of the Equator, says project leader Gerhard Beinhauer, comes a fitting celebration "with King Neptune, assisted by Helios, the god of the sun." —*Erin Friar McDermott*

THE ROUTE

During its attempt to circumnavigate the world, the *Tûranor PlanetSolar* aims to remain mostly within 30 latitudinal degrees of the Equator to maximize its exposure to the sun.





PHOTO: PLANETSOLAR. NGM MAPS

HISTORY

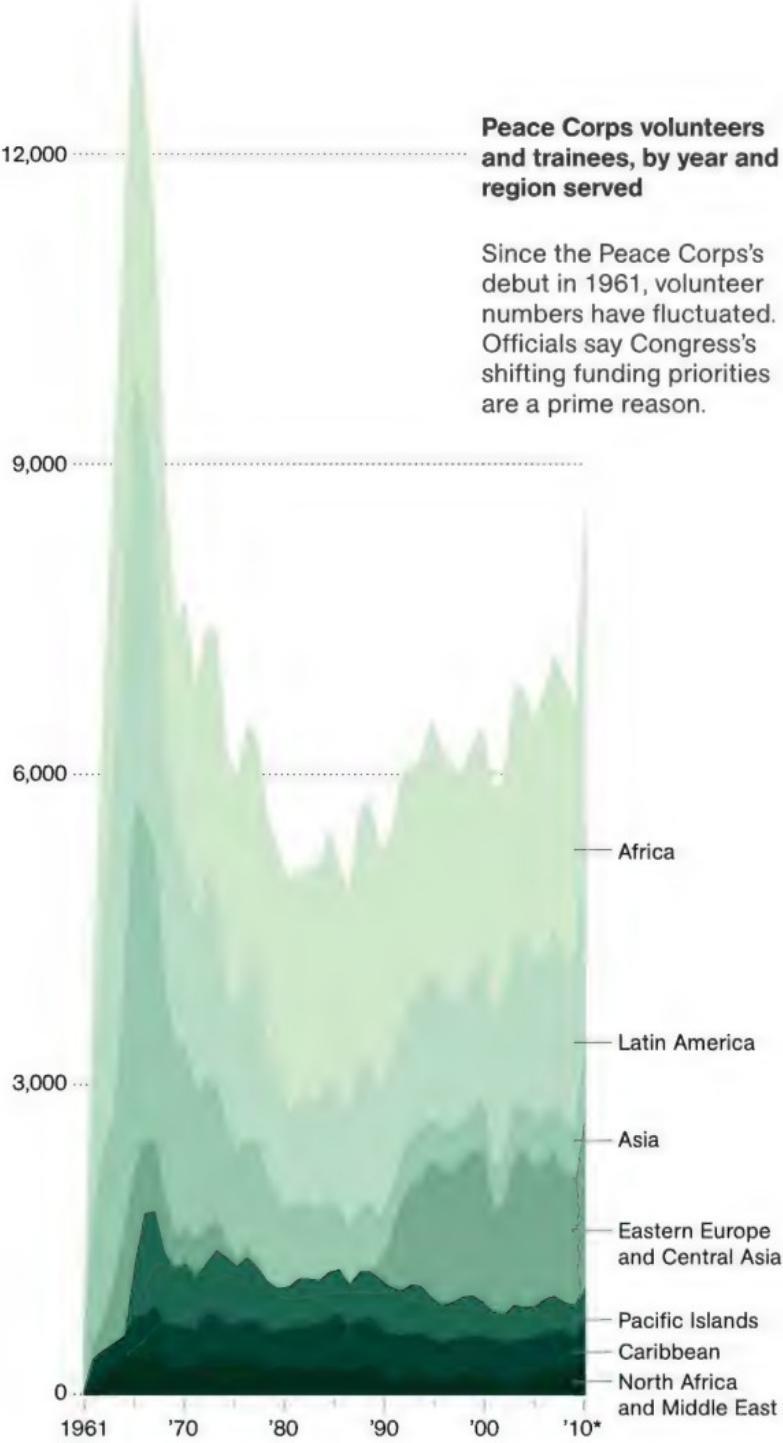
Peace Corps Rising Fifty years ago 51 Americans arrived in Ghana to “promote world peace and friendship.” Since then, more than 200,000 volunteers—ages 18 to 86, some now diplomats and politicians—have served in 139 nations.

But the Peace Corps is no fame game or numbers story; it's a sign of the times. Historian Stanley Meisler says participation dipped as the Nixon Vietnam era “took the shine off doing something for the U.S.” As memories faded, the luster of service returned. Now, on the group's golden anniversary, Oval Office support and recession woes are lifting enlistment.

Next, says director Aaron S. Williams: Help out in Haiti, continue to empower women, improve food security. Competition for recruits? No problem. “The service pie is growing bigger,” he says, “and we're going to get a larger slice.” —*Jeremy Berlin*

Peace Corps volunteers and trainees, by year and region served

Since the Peace Corps's debut in 1961, volunteer numbers have fluctuated. Officials say Congress's shifting funding priorities are a prime reason.



The New Moon

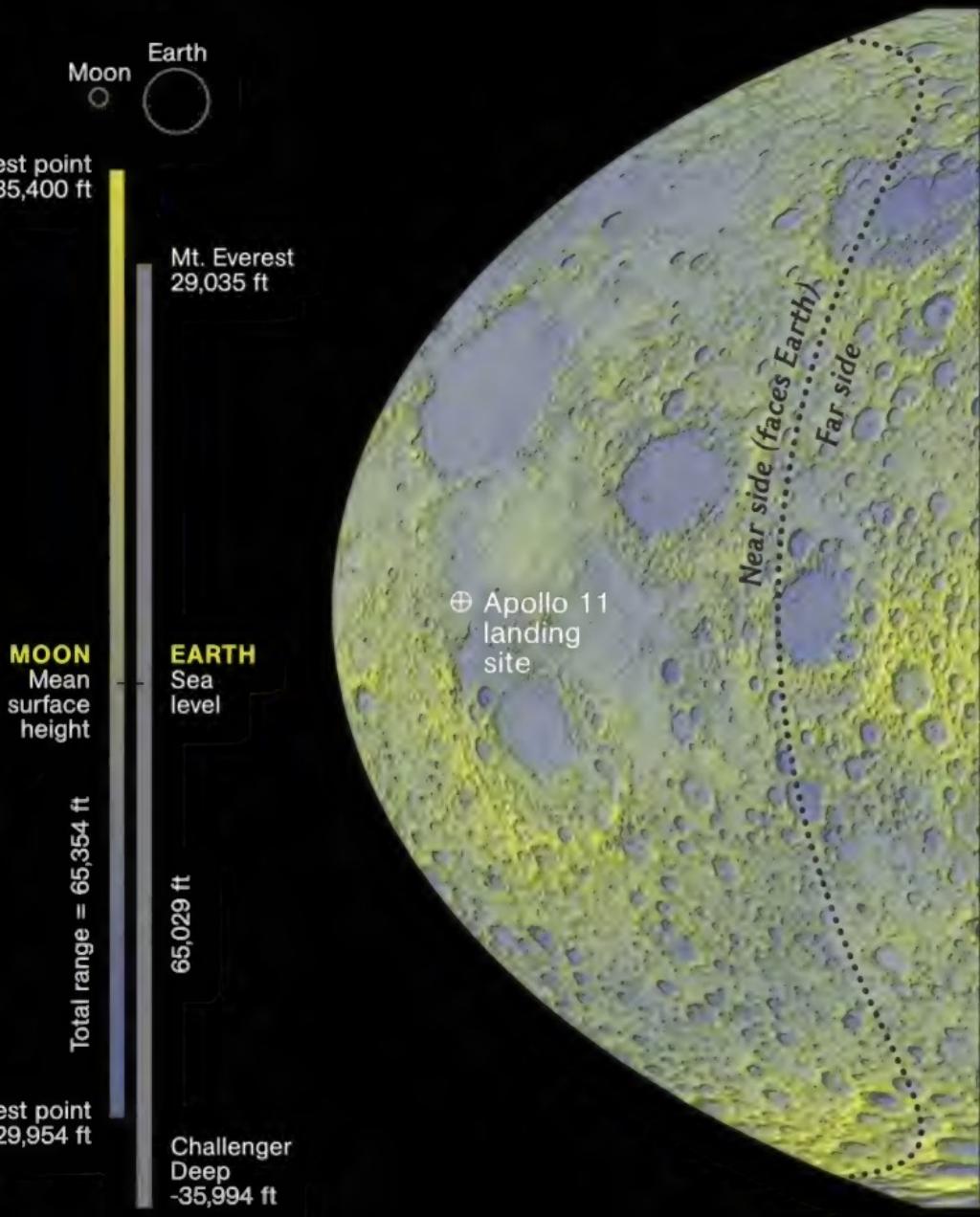
A lunar portrait—and an early history of our solar system—is emerging from a wealth of fresh topographic data.

Move over, man in the moon. Now there's more to see, thanks to the first detailed lunar-surface map. Since 2009 NASA's Lunar Reconnaissance Orbiter has been bouncing laser beams off the moon to gauge elevation. Last fall the results emerged as a high-resolution map (right), including a point over a mile higher than Mount Everest and a complete catalog of 5,185 craters wider than 12.5 miles. The impact pattern suggests that around 3.8 billion years ago two asteroid storms pelted the moon and the Earth, whose dynamic crust retains fewer celestial fingerprints.

Also newly found: frozen water in craters at the lunar poles—the coldest known spots in our solar system. "This is a renaissance period in moon studies," says NASA's Richard Vondrak. With surveys of Mars and Mercury also under way, more cosmic folklore may soon be jettisoned as well. —*Jeremy Berlin*

Higher

Lower



Near side (faces Earth)

Far side

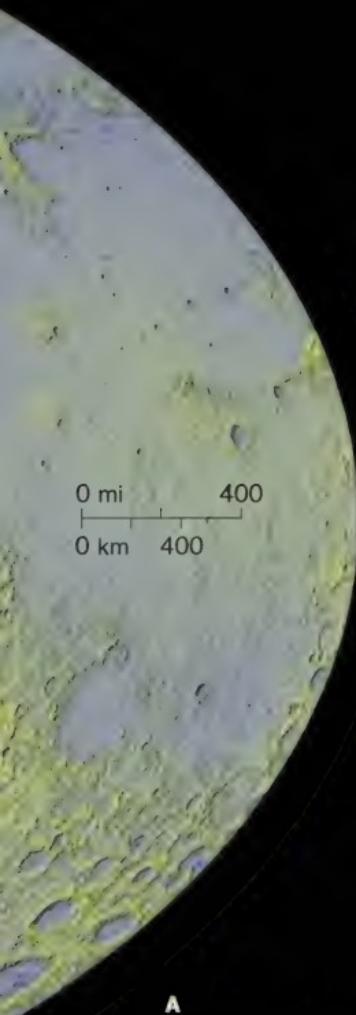
HIGHEST
+ POINT

A

B

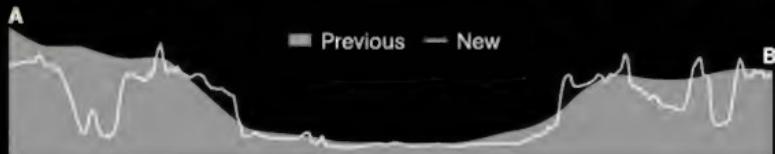
Profile
below

LOWEST
+ POINT



MOON BEAMED

Three billion surface readings by the Lunar Orbiter Laser Altimeter reveal a landscape more rugged than previously thought.



SAM PEPPLE. SOURCE: NASA LUNAR ORBITER LASER ALTIMETER

CONSERVATION

Dolphin Delivery The pink river dolphin of Bolivia is the landlocked country's only cetacean—a colorful but unprotected character known locally as the *buefo*. No wonder, then, that scientists and environmentalists scrambled last spring after 20 of these mammals got stuck in a half-mile-long, five-foot-deep part of the drought-stricken Pailas River, a tributary of the Grande River.

By August a rescue was under way. Workers led by Enzo Aliaga-Rossel (right, at far left) and another zoologist spent 12 days hoisting dolphins into boats with fishing nets and covering them with wet cloths. They were then placed in tanks in mattress-padded trucks and transported three hours, by land and water, to a release site on the

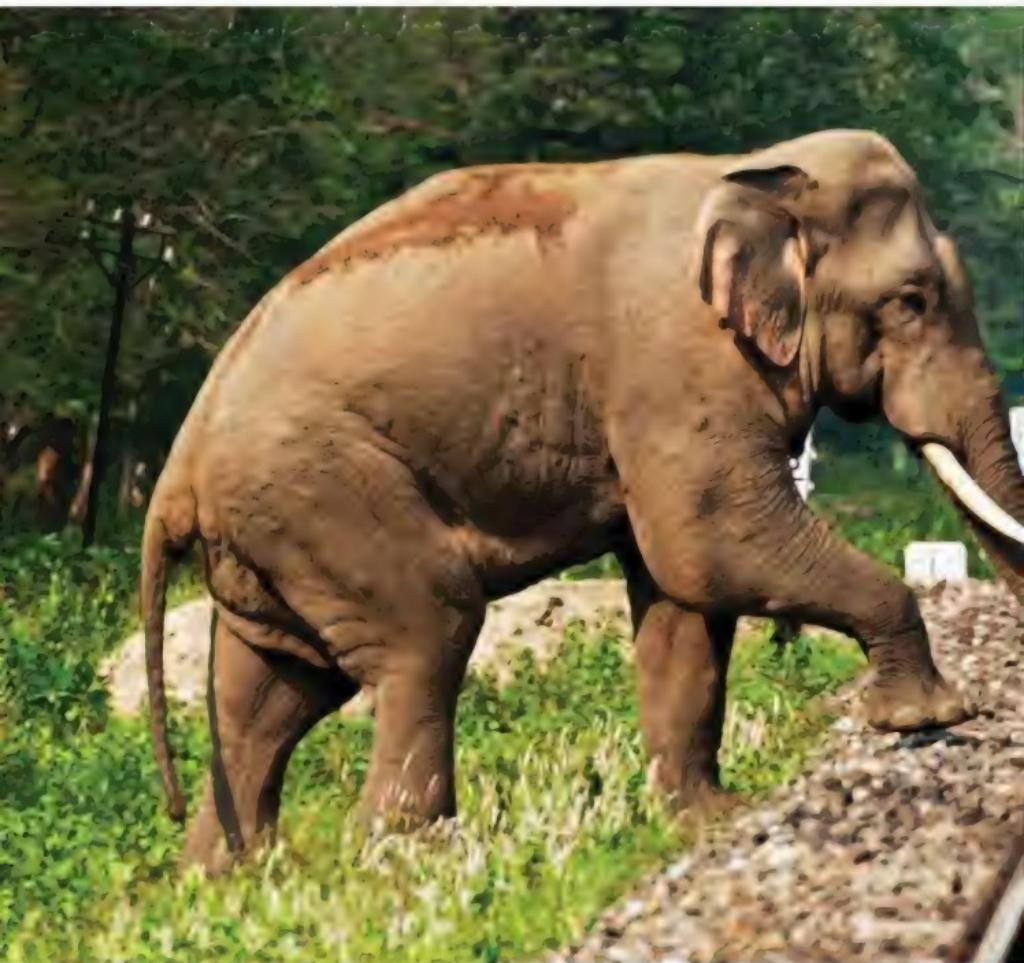
Grande. All were saved, says Aliaga-Rossel, adding that greater human awareness is key to a rosy *buefo* future.
—Catherine Zuckerman





Rescuers pull a dolphin from the too shallow Pailas River in Bolivia.

CONSERVATION





Elephants at Risk

The protected pachyderms of West Bengal, India—such as those in the Mahananda Wildlife Sanctuary (left)—are hardly out of harm's way. In fact, since 2004, 27 have been killed by trains barreling down the hundred miles of track that run where they roam. Now the Ministry of Railways is under pressure from conservationists and the environmental ministry to enforce speed limits, reduce travel at night (when most casualties occur), and prune vegetation to improve the driver's view. —Catherine Zuckerman

HOW TO (RE)GROW A KIDNEY

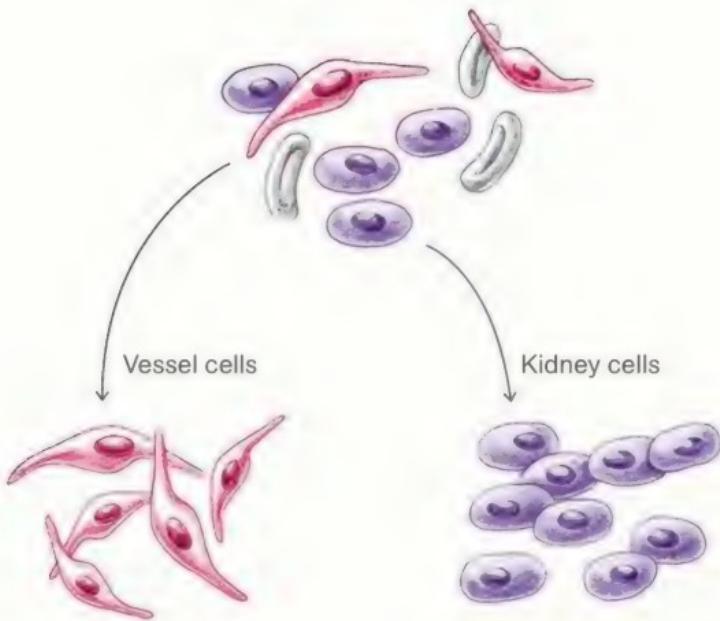
More people are waiting for kidneys than any other organ, but it's one of the hardest to grow. A transplantable "bioartificial" kidney is many years away. Here's the strategy being followed at Wake Forest.



1

Sample

a tiny bit of the patient's kidney.



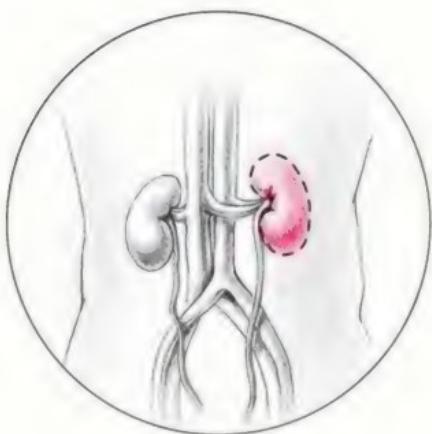
2 Sort
kidney tissue cells
from those of
blood vessels
running through it.

3 Multiply
both types
of cells in
lab cultures.



- 4 Seed**
the cultured cells of the patient onto a scaffold, which is made from a pig kidney by washing it with mild detergent until the pig cells are gone and only the tough collagen remains.

5



8 weeks later

Incubate
at 98.6°F in a bio-reactor that delivers oxygen and nutrients to the growing tissue.

6 **Implant**
into the patient a functioning human organ—his own.



Daisy Mae, a miniature Vietnamese potbellied pig, lounges like a family member in West St. Paul, Minnesota.



Only a handful of wild animal species have been successfully bred to get along with humans. The reason, scientists say, is found in their genes.

Taming the Wild





DECISION TIME

Dogs, but not chimpanzees, will follow a finger with their eyes to hidden food—testament to their close social bond with humans. In this experiment at Duke University, will Tasmania favor the pointing of a known caretaker (at left) over that of a stranger?







GONE TO EXTREMES

Two chickens, both eight weeks old but vastly different in weight, show off size-based breeding by geneticist Paul Siegel at Virginia Tech. "We're using artificial selection as a tool to look at natural selection. We just accelerate it."





IMPROBABLE PETS

Foxes bred through generations to be as human-friendly as dogs get a boost from Lyudmila Trut (center) and other staff at the Institute of Cytology and Genetics, in Novosibirsk, Siberia.





A DOG'S LIFE

Alisa, one of two Novosibirsk foxes living as pets in a wealthy home outside St. Petersburg, is friendly with her human companions and with the family's yellow Labrador too.

Making Friends

Beginning in 1959, researchers in Siberia selectively bred foxes to encourage friendliness toward humans. Over generations, other behavioral traits that distinguish dogs from wild canids emerged, followed by changes in morphology (next screen).

BEHAVIORIAL CHANGES

2nd generation (1962)

1960

1975

4th (1964)

Approachability

Aggressive response to humans starts to disappear.

Tail wagging

Some kits (pups) wag tails and approach humans voluntarily.



MORE >

6th (1966)

Petting

Kits whimper, allow themselves to be petted and carried.



Full affinity

When let out of cage, friendliest kits follow humans and lick them.



MORPHOLOGICAL CHANGES

9th (1969)



Floppy ears

Instead of pricking up soon after birth, ears stay floppy up to three months.

Coat-color variation

First kits born with piebald (spotted) fur and star pattern on forehead.



FERNANDO G. BAPTISTA AND
MARGUERITE B. HUNSIKER, NGM STAFF
SOURCE: LYUDMILA N. TRUT, INSTITUTE
OF CYTOLOGY AND GENETICS OF THE
SIBERIAN BRANCH OF THE RUSSIAN
ACADEMY OF SCIENCES

13th (1973)

15th (1975)

Curly Tail

Untamed foxes' tails point down; tamed ones' curl up upon seeing humans.

Shorter tail

Rarely, vertebrae are shorter, thicker, and fewer in number.

Three to six
fewer vertebrae





SHORT HOP Two wolves and a wolf-dog hybrid (foreground), traveling ambassadors for a sanctuary for captive-born wolves, illustrate the genetic stepping-off point for all dog breeds.



BRED TO BE BAD

This brown rat's angry display at the photographer reflects 73 generations of breeding for hostility to humans. Scientists at Novosibirsk and in Germany are comparing the aggressive rat genome to that of rats selected for friendliness, attempting to untangle connections between DNA and behavior.









MOTHER OF ALL HENS

Wild red jungle fowl, progenitors of the modern chicken, crowd a pen near Statesboro, Georgia. Remnants of a population collected in north-central India in the early 1960s, these birds may be the last of their kind—genetically speaking. As humans push farther into the wild bird's South Asian habitat, the chickens they bring with them interbreed with jungle fowl, polluting their genomes.



Out of the Wild

Only a few animal species have proved capable of being domesticated. Valued for food, skins, transport, companionship, or sentry, most were domesticated in Asia, where humans first began cultivating crops as well.

- Asia
- Africa
- North America
- South America



15,000 YEARS AGO



Sheep



Goat



Cow



Pig

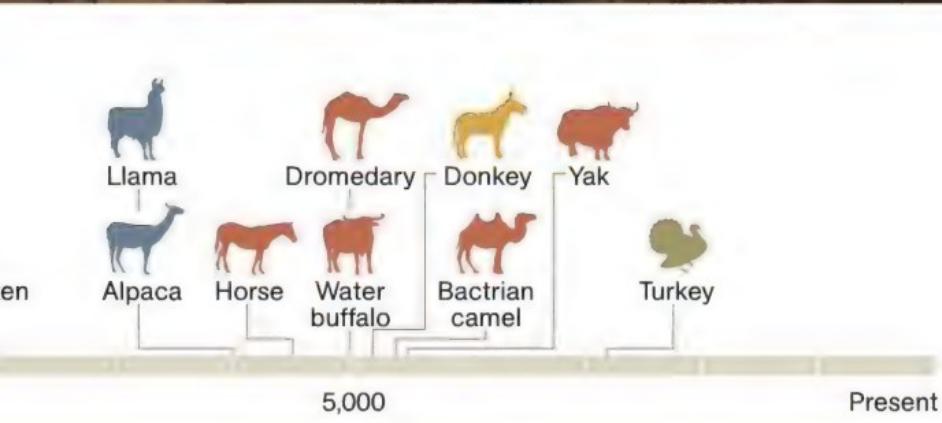


Cat



Chick

10,000





ANCIENT BOND

A woman milks a mare in the village of Kogershin in southern Kazakhstan. Recent archaeological studies have shown that the Botai people of the Eurasian steppes were the first to actively domesticate horses, 5,500 years ago.









COLUMBIA



NATURAL COLORED



KATAHDIN HAIR



NORTH COUNTRY CHEVIOT



KATAHDIN HAIR

WORTHY BREEDS

A sampling of sheep at the Indiana State Fair reflects the diversity wrought by thousands of years of breeding. In the United Kingdom farmers bring their sheep to the Scottish Agricultural College in Edinburgh, where a CT scanner (right) analyzes the "carcass quality" of live animals, so the best can be selected for breeding.

SOMAT
E



NO HIDING THE HIDE

Piebald coats like the one on this Holstein cow are a signature trait of domesticated animals. An easy target for predators in the wild, piebald fur may have been selected for by humans to differentiate among livestock.





Oil transformed Dubai in the 1970s. The city now boasts the world's tallest building, giant malls, and some two million residents, who depend on desalinated seawater and air-conditioning—and thus on cheap energy—to live in the Arabian desert.

JENS NEUMANN / EDGAR RODTMANN



ENTER THE
ANTHROPOCENE

AGE OF MAN

It's a new name for a new geologic epoch—one defined by our own massive impact on the planet. That mark will endure in the geologic record long after our cities have crumbled.





CHANGING SEAS

Rosignano Solvay, Italy

Photograph by MASSIMO VITALI



A Tuscan beach captures the textured drama of humans and the sea. The "tropical" sands aren't natural; they're whitened by carbonates from the chemical plant, which also discharged mercury until recently. The plant converts salt extracted from the sea into chlorine and other essential products. Fossil fuels power such transformations; worldwide, the CO₂ from smokestacks and tailpipes is slowly acidifying the ocean, threatening marine life.



THE OIL CENTURY

South Belridge, California
EDWARD BURTYNSKY



Discovered in 1911, this field pumped on as cities were rebuilt for cars and as ancient petroleum molecules were spun into household products such as plastics, cosmetics, and pharmaceuticals. South Belridge today produces 32 million barrels a year—enough for nine hours of world demand. In this century the world's supply may plummet.



MOVING MOUNTAINS

Kayford Mountain, West Virginia
J HENRY FAIR



As oil companies drill deeper for offshore oil, mining companies work 24/7 to level Appalachian peaks for coal, which supplies half of U.S. electricity. This summit vanished in a day. Some 470 have been erased since the 1980s; the waste often buries streams. Mountaintop removal recovers just 6 percent of a coal deposit.





THE SIXTH MASS EXTINCTION

Museum of History,
Aralsk, Kazakhstan
CAROLYN DRAKE

The ship sturgeon is near extinction, and it's already gone from the Aral Sea; water diversion for cotton farming reduced what was once the world's fourth largest lake to a dust bowl. In the past half billion years asteroid impacts and other natural events have caused five catastrophic mass extinctions of plants and animals. Humans may be causing a sixth.

Why Is Our Impact Growing?

Is population growth the root cause? Or is it affluence, which leads to greater consumption of energy and other resources? Or technology, which offers new tools for exploiting and consuming? The IPAT formula is a way of thinking about the issue: It says the three factors compound. Since 1900 world GDP (a measure of A) and the number of patent applications (a measure of T) have grown even faster than population.

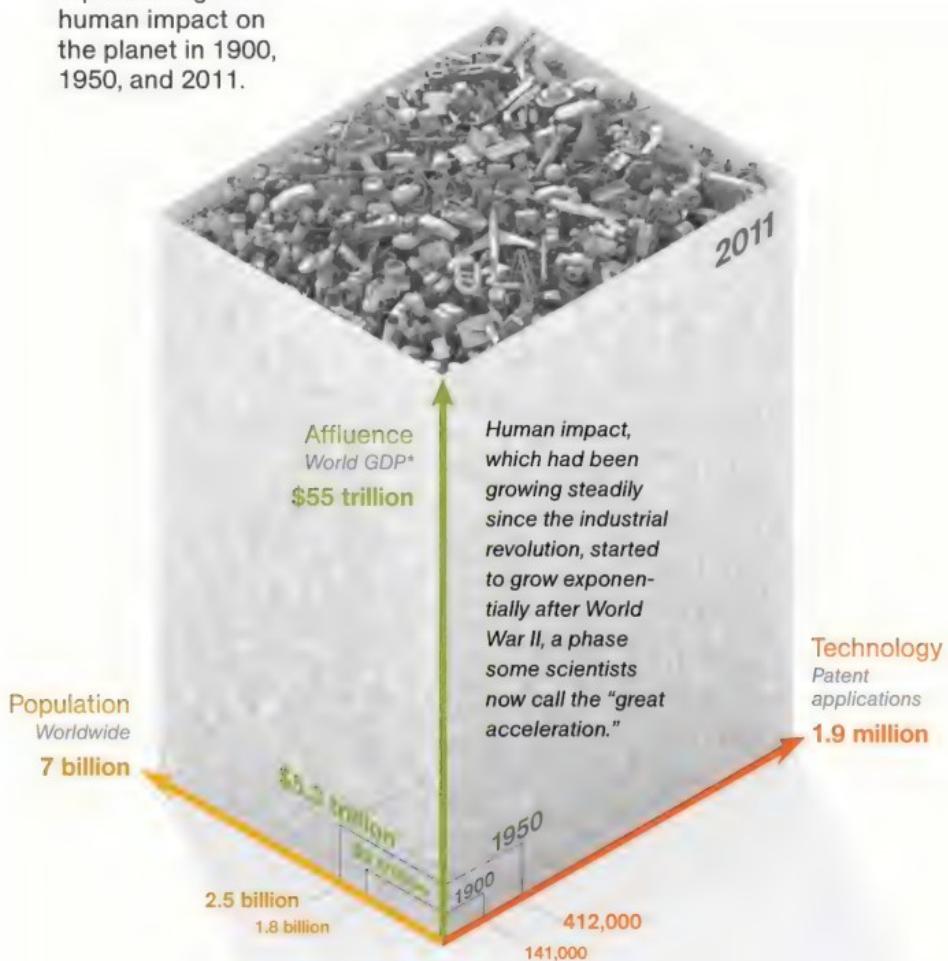
$$I = P \times A \times T$$

Human Impact Population Affluence Technology

*GDP FIGURES ARE CONSTANT 1990 INTERNATIONAL DOLLARS.

JOHN TOMANIO, NGM STAFF. ART: BRYAN CHRISTIE. SOURCES: UNITED NATIONS; ANGUS MADDISON, "STATISTICS ON WORLD POPULATION, GDP AND PER CAPITA GDP, 1-2008 AD," UNIVERSITY OF GRONINGEN; WORLD BANK; WORLD INTELLECTUAL PROPERTY ORGANIZATION

$P \times A \times T =$ width
times height times
length of three boxes
representing the
human impact on
the planet in 1900,
1950, and 2011.







INDUSTRIAL FARMING

Almeria Province,
Spain

EDWARD BURTYNSKY

On the arid plains of southern Spain, produce is grown under the world's largest array of greenhouses and trucked north. Greenhouses use water and nutrients efficiently and produce all year—tomatoes in winter, for instance. But globally the challenge is grain and meat, not tomatoes. It takes 38 percent of Earth's ice-free surface to feed seven billion people today, and two billion more are expected by 2050.





FOOD CHEMISTRY

El Ejido, Spain
REINALDO LOUREIRO

Fertilizers and pesticides make possible the high yields and flawless produce celebrated by this Spanish billboard. The side effects are far-reaching—nitrogen runoff from fertilized land, for example, causes dead zones at the mouths of rivers worldwide.





A DAMMED WORLD

Hoover Dam and
Lake Mead, Nevada
MITCH EPSTEIN

Dams tame floods, water crops (and people), and generate 16 percent of the world's electricity, carbon free. They have also displaced 40 to 80 million people and destroyed river ecosystems. More than half the world's large rivers are now dammed. Some, like the Colorado, are tapped out. Persistent drought has left a "bathtub ring" in Lake Mead, which supplies water to much of the Southwest.





Kudzu, a fast-growing Asian vine, has smothered millions of acres in the United States since it was planted in the 1930s to control erosion. Exotics spread by humans are a global threat to biodiversity. Most of the species on the U.S. threatened and endangered lists are there in part because of foreign invaders.





A TIDE OF WASTE

Chittagong,
Bangladesh

EDWARD BURTYNSKY

Ship breaking delivers jobs to Bangladesh and a wealth of scrap metal—but also asbestos, PCBs, and other toxics. Though waste recycling generally is booming, so is waste production. In American cities in recent decades, the two trends have just about offset each other.





URBAN SUPERSPRAWL

Mexico City, Mexico
PABLO LÓPEZ LUZ

Some 20 million people live in Mexico City, the world's fifth largest metropolitan area. In 1800 the urban fraction of the global population was 3 percent. Today it is 50 percent and rising. In crowded shantytowns, the need for clean water and sanitation is urgent. But urbanization has an upside: Per capita, cities use less energy and pollute less than rural areas.

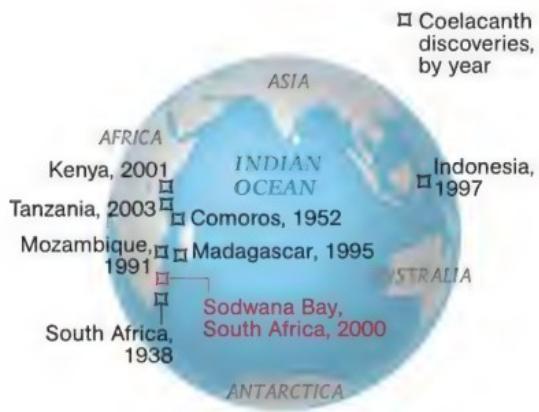
During 95 hours of diving, the photographer and his team spent a total of 81 minutes swimming alongside four coelacanths. The fish are easily distinguished by distinctive white markings.





The coelacanth was thought to have gone extinct with the dinosaurs. Rediscovered in 1938, it is chronicled here in a rare photographic account.

Ancient Swimmers



The elusive fish has been found along the eastern coast of Africa as well as Indonesia. The largest-known group—300 or so—lives near the island nation of Comoros. The expedition team (right) made 21 dives to depths of 300 to 400 feet in South Africa's Sodwana Bay area. Over the course of four weeks, they spotted coelacanths only six times. The nocturnal animals hide in underwater caves by day, then venture out at night, feeding on small fish, squid, and octopus.









A crystal layer behind the coelacanth's retina reflects light like a mirror, a boon in the ocean's dim waters. Its sail-like first dorsal fin provides stability while swimming. An extra tail lobe, unique to coelacanths, can be seen today and in fossils from millions of years ago.

PHOTOGRAPHS BY LAURENT BALLES



French biologist and prize-winning photographer Laurent Ballesesta co-authored the documentary *The Science of Shark Sex*.

It's not every day a coelacanth shows up in a tank.

But that's what happened in 1938, when Marjorie Courtenay-Latimer spotted a coelacanth with three dorsal fins, and an extra lobe on its pectoral fin. Though she didn't know it straight away, she had just discovered the coelacanth, which was assumed to have gone extinct during the Cretaceous period but somehow outlasted it, living deep in the ocean, undisturbed.

Since this chance sighting, *L. maculatus* has been found in pockets in the Indian Ocean. No more than a few as 1,000 or as many as 10,000 individuals have mainly been photographed by scuba divers. Divers first documented a coelacanth off the coast of Port Elizabeth, South Africa. —Caroline S. Williams

ay that a living fossil fisherman's net.

In 1938, when a South African museum curator named Alan Southgate pieced together a bizarre creature with thick scales, unusual nostrils, and a long, thin tail, amid an otherwise ordinary haul of fish. Right away, Courtenay-Latimer had rediscovered a species that had seemed to have died out at the end of the Cretaceous period. It had survived—outlasted many of its prehistoric peers, dwelling in deep, dark, cold water—and undetected—for eons.

Latimeria chalumnae have been found in several locations around Africa since 1938. No one knows how many there are—maybe as few as 1,000. Because of the depth of their habitat, they have not been seen by submersibles and remotely operated vehicles since 1990. In December 2009, researchers caught a female specimen of the fish in 2000; in January and February 2010, they descended to 1,300 feet to take pictures of a small colony in Sodwana Bay, South Africa. *Latimeria chalumnae* are the last survivors of a group of ancient fish that once swam the oceans.

—Sylvyn Butler

Fossil Fish

Named by a 19th-century naturalist, “coelacanth” comes from the Greek for “hollow spine”—a reference to the hollow spines that are part of its fin structure.

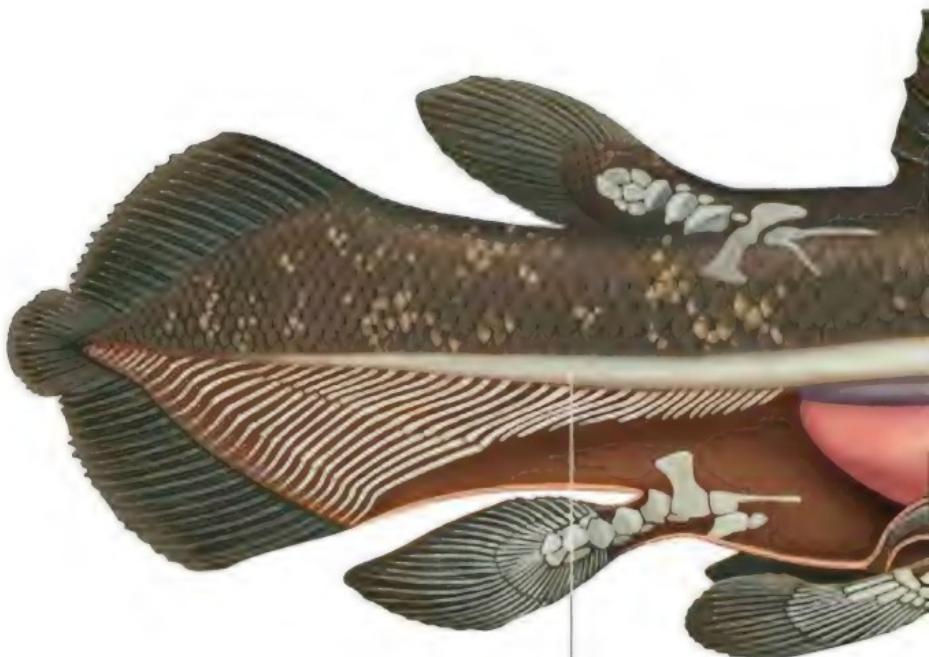




PHOTO: COLIN KEATES, DK LIMITED/CORBIS

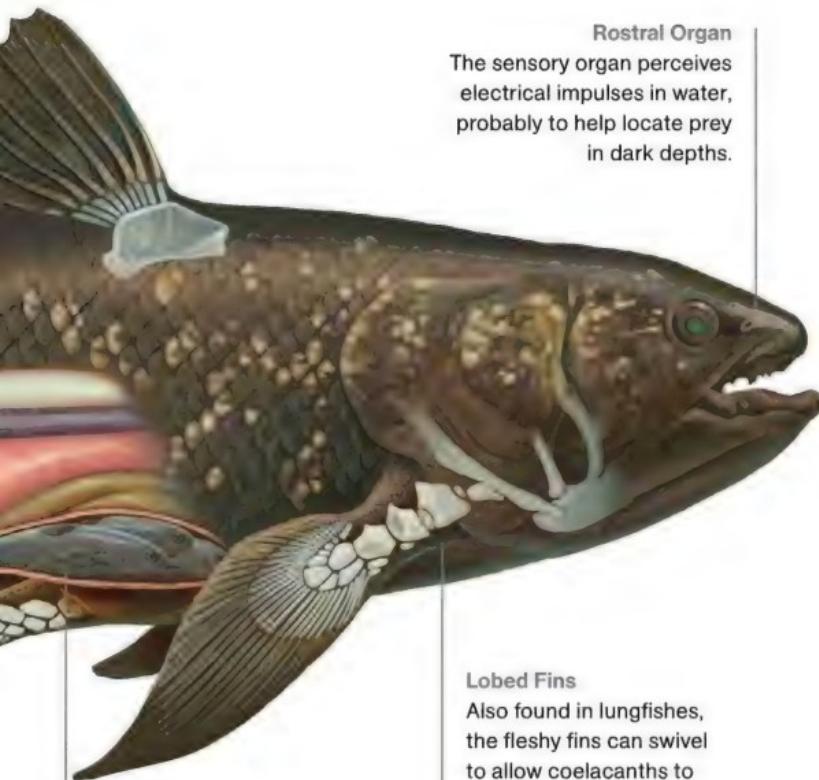
Ancient Anatomy

The primitive-looking coelacanth can grow to about six feet and nearly 200 pounds.



Notochord

This tough, elastic tube, which is partially hollow and filled with fluid, acts as a spine for the coelacanth.



Rostral Organ

The sensory organ perceives electrical impulses in water, probably to help locate prey in dark depths.

Lobed Fins

Also found in lungfishes, the fleshy fins can swivel to allow coelacanths to maneuver precisely.

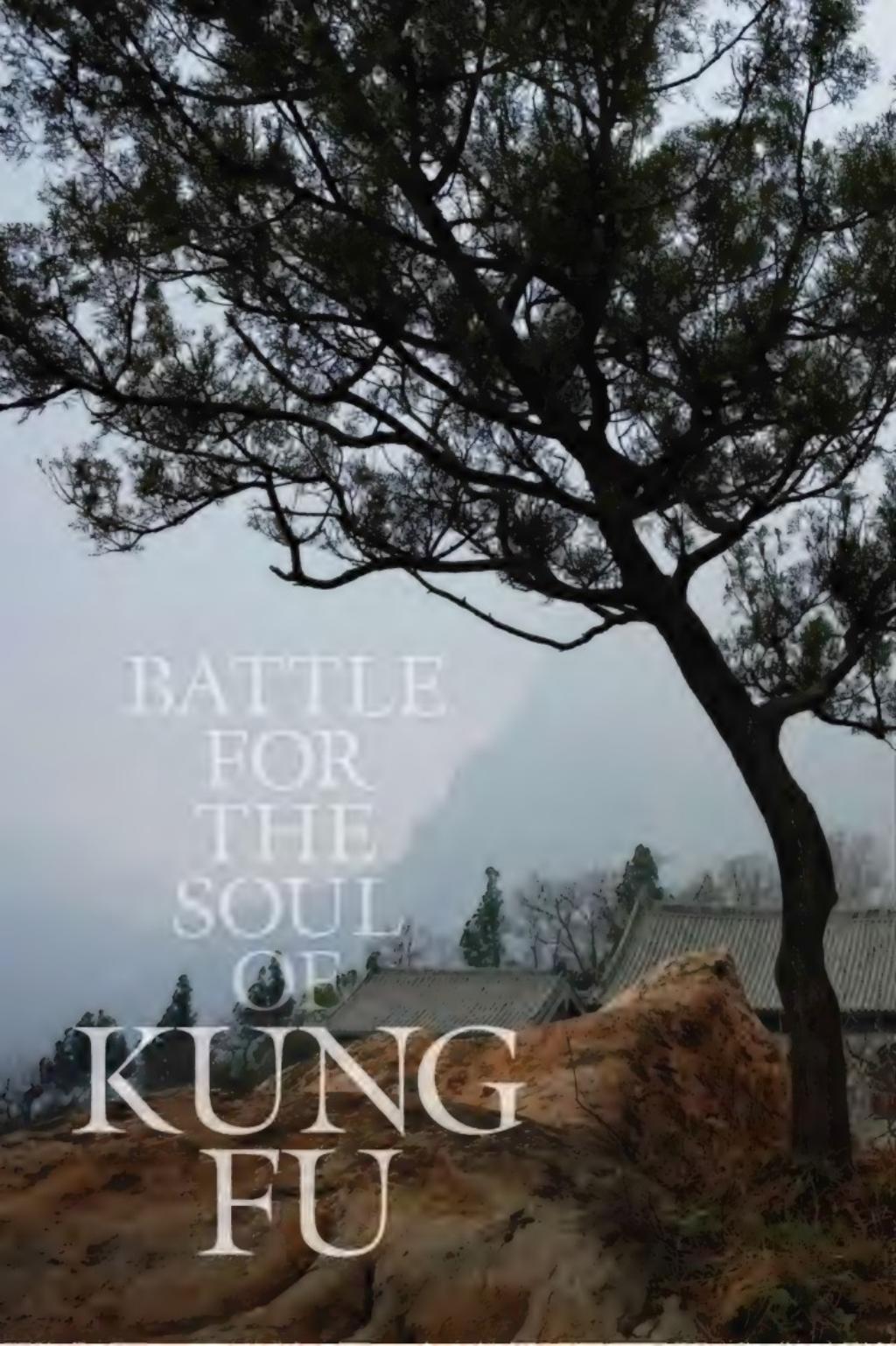
Live litter of pups

Coelacanths give birth to a litter of up to 26 live and fully developed "pups." Gestation is likely a year or more.

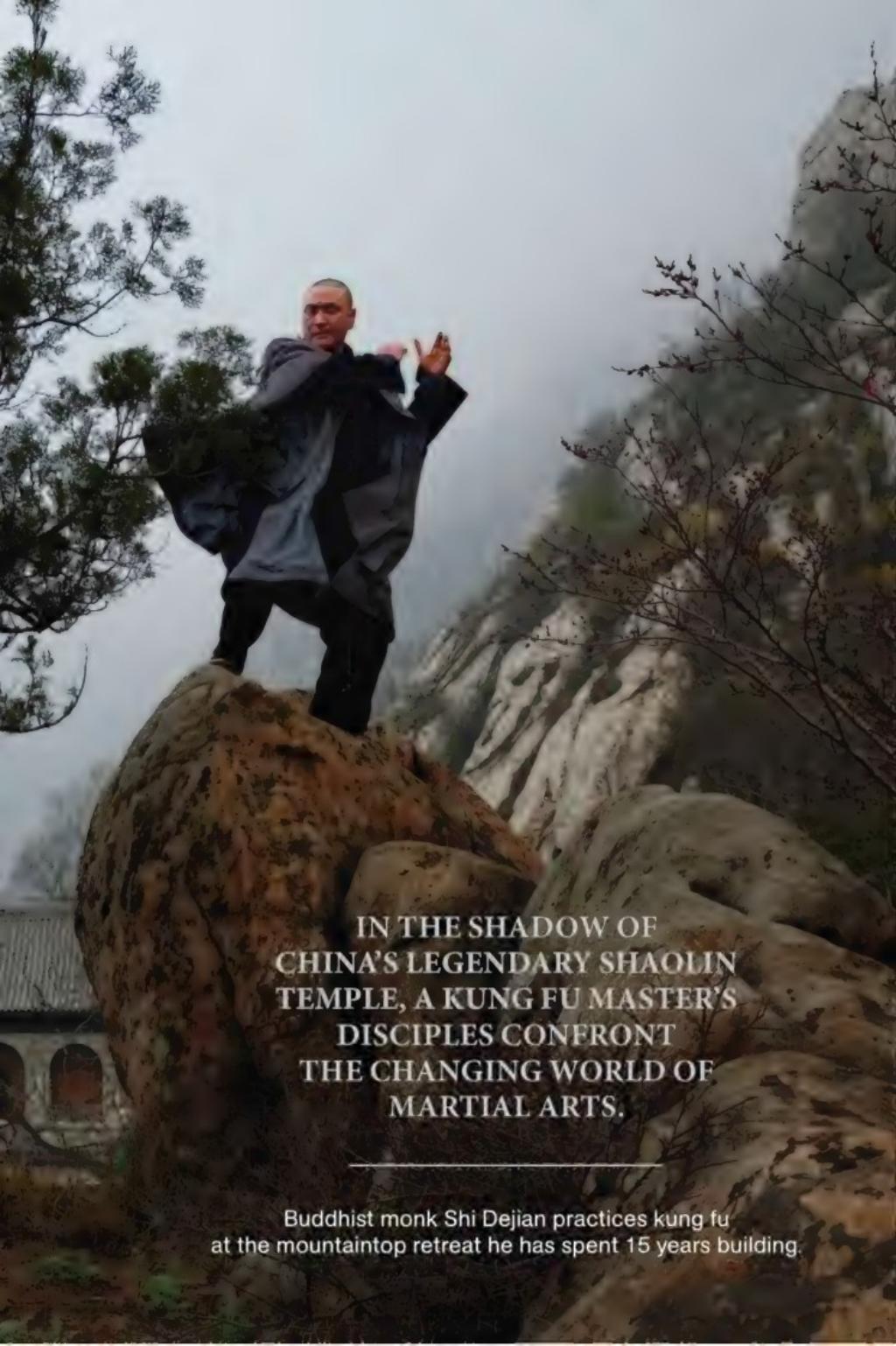
The coelacanth's slow, graceful stroke is like no other fish's. It moves left pectoral and right pelvic fins, then right pectoral and left pelvic fins—akin to the cross-step of tetrapods. When the expedition team visited in early 2010, the coelacanths ignored the humans, says photographer Ballesta, except the one below: "This is the moment he tried to smile to me."







BATTLE
FOR THE
SOUL
OF
**KUNG
FU**

A black and white photograph of a Buddhist monk, Shi Dejian, standing on a large, mossy rock. He is in a dynamic kung fu pose, with one leg bent and his hands raised in a circular motion. He is wearing a dark, traditional robe. The background shows a misty mountain landscape with pine trees on the left.

IN THE SHADOW OF
CHINA'S LEGENDARY SHAOLIN
TEMPLE, A KUNG FU MASTER'S
DISCIPLES CONFRONT
THE CHANGING WORLD OF
MARTIAL ARTS.

Buddhist monk Shi Dejian practices kung fu at the mountaintop retreat he has spent 15 years building.





Teenagers at the Shaolin Tagou Martial Arts School in Dengfeng unleash a 20-minute flurry of fists and feet to build stamina. The city has become China's kung fu capital, boasting more than 60 martial arts schools and 50,000 students from all over China.



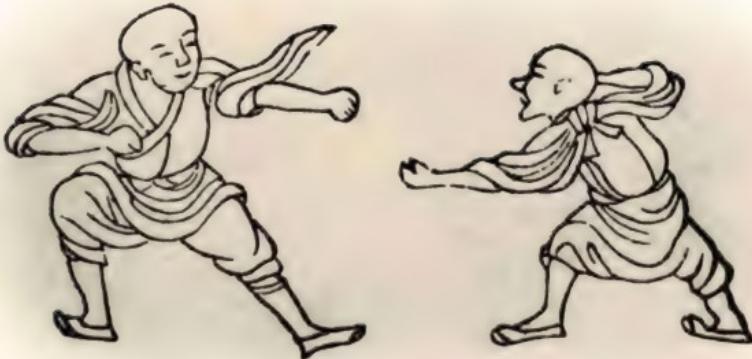


Students form a Chinese flag at the Tagou complex near the Song Mountains. As China's largest martial arts school, with 25,000 pupils, Tagou's specialties include large-scale shows. Its students performed at the Beijing Olympics opening and closing ceremonies.





Kung fu master Yang Guiwu, who died at age 77, is mourned by his family, dressed in traditional funeral robes. Yang's kung fu lineage extends back through generations of Shaolin monks. His own disciples are expected to pass on his teachings.



SHAOLIN THROUGH THE AGES

11th century B.C.
Oldest Chinese
reference
to martial arts.

A.D. 495
Shaolin Temple
founded by
Indian Buddhist.

621 Thirteen
Shaolin monks
battle opponents
of Tang rule,
are honored
by prince.

1898-1901
Martial artists
foment the
Boxer Rebellion
to challenge
Western
influence.

1928 Warlord
Shi Yousan
burns Shaolin
Temple, obliter-
ating its vast
library, including
ancient martial
arts texts.

1940s Shaolin
monks ambush
Japanese sol-
diers patrolling
near the temple.

1350s Temple sacked by marauders, one of many such events in its history.

1553 Shaolin monks help fight off Japanese pirate attacks on Chinese coast.

2010 Shaolin Temple named a UNESCO World Heritage site.

1966 Cultural Revolution's Red Guards ravage Shaolin Temple, beat the few remaining monks.

1972 Kung Fu TV series begins, introducing the Shaolin Temple to Americans.

1982 Martial arts champ Jet Li portrays a heroic monk in *Shaolin Temple*, a film that sets off a Shaolin frenzy in China.

1999 Shi Yongxin installed as the 30th abbot of the Shaolin Temple.





Like other martial artists of his generation, Fan Fuzhong, 75, has seen kung fu banned by Japanese occupiers, discouraged by Mao's Red Guards, and resurrected as a cultural treasure in the new China.





In a scene for a Chinese TV series, stuntmen portray Shaolin monks battling bandit gangs during the Qing dynasty. Not your average nonviolent Buddhists, the monks loom as heroes in the national psyche.





"Gained merit in battle" reads the epitaph of two of the 231 eminent Shaolin monks honored with shrines in the Pagoda Forest. The number of layers in a shrine reflects a monk's virtue; his bones, and often those of disciples, are buried below.





Monks file to prayer in the Shaolin Temple. Some 150 monks live at the temple, and visiting monks from across China and abroad come to study and meditate at the purported fountainhead of Zen Buddhism.





A monk seeks shelter from a snow shower in the Shaolin complex, lavishly rebuilt in recent years. Stone tablets throughout the grounds testify to the generosity of patrons from all over the world.





In their future careers Tagou pupils likely won't hit anyone with a staff. Yet the discipline and character they develop while perfecting its use, say their coaches, are weapons they will wield over their lifetimes.

THEY ARE THE EARTH'S POLLINATOR



S. AND THEY COME IN MORE THAN 200,000 SHAPES AND SIZES.

Gold Dusters



The perfume of the rare caper flower on Kauai tempts a hungry honeybee at dusk.

APIS MELLIFERA ON CAPPARIS SANDWICHIANA, HAWAII





With a vigorous quiver, an Arizona sweat bee "buzz pollinates" a deadly nightshade flower. Its vibrating body shakes free the golden dust that will feed the larvae back in the nest—and promise the plant's DNA a future.

AGAPOSTEMON SP. ON SOLANUM ROSTRATUM, ARIZONA





Beetles are among the most ancient pollen carriers. This soldier beetle (above) munches a magnolia, which emits both scent and heat as lures. A bog orchid's pollen packet sits at the flower's mouth, ensuring that a probing mosquito gets a proboscisful (left).

Bees are the most prolific pollinators, but they're not alone. The tarantula hawk wasp feeds on milkweed pollen.

PEPSIS SP. ON ASCLEPIAS SUBULATA,
ARIZONA



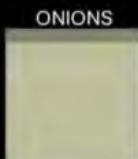


WHAT POLLEN IS WORTH

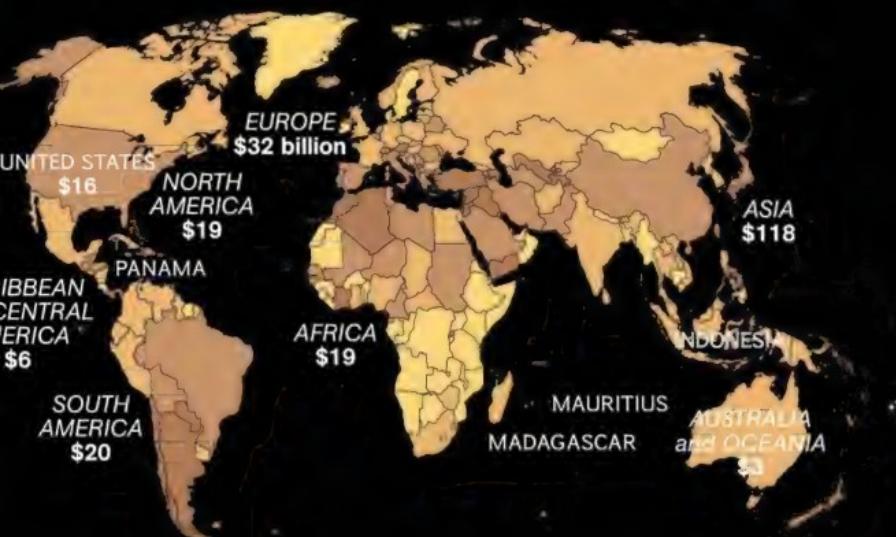
Pollinators, especially bees, make the global garden grow. Insect pollination is worth more than \$200 billion worldwide. Vegetables, fruits, oils, and some nuts, the biggest contributors to that total value, are also the most vulnerable to insect declines. Of less concern: cereals, sugars, roots, and tubers, which self-pollinate or rely on wind.

U.S. Crop Pollination

- Dependent on other insect pollinators
- Dependent on honeybees
- Not dependent



CAR
and C
AM

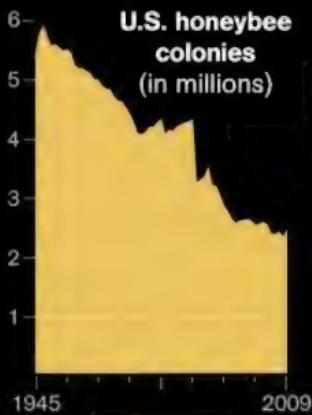


MARIEL FUBLONG AND LISA B. BITTER, NGM STAFF; COLTER SIKORA

SOURCES: NICHOLAS CALDERONE, CORNELL UNIVERSITY (GRAPHIC); MICHAEL RUGGIERO, EXPERT SOLUTIONS INTERNATIONAL (U.S. MAP, 2008 USDA DATA); NICOLA GALLAI, FRENCH NATIONAL INSTITUTE FOR AGRICULTURAL RESEARCH (WORLD MAP, 2008 FAO DATA)

HONEYBEE HEALTH

In 2010, scientists reported a possible cause of colony collapse disorder (CCD), the rapid die-off of millions of honeybees in many countries since 2006. Genetic studies pointed to a particular insect virus and fungus at work together. But those findings have come under debate, and definitive conclusions remain elusive. "CCD is likely a complex interaction," says the USDA's Jeff Pettis. "But the role of this pair of pathogens is still an open question." Meanwhile, the blood-sucking *Varroa* mite (red dots right), also implicated in CCD, remains honeybees' most devastating pest worldwide.





APIS MELLIFERA INFESTED WITH VARROA DESTRUCTOR

Spring fog drifts over a Pennsylvania apple orchard at sunrise. Each year, owner John Lerew rents 180 honeybee hives holding millions of bees to pollinate several hundred acres. Most large farms bring in managed bees like these. "For us," says Lerew, "they're a must."

AMY TOENSING





An ornate day gecko laps nectar from tree blossoms on Mauritius. Rare pollinators, bug-eating lizards may substitute on islands where neither pollinators nor predators are plentiful—filling a niche held by others on the mainland.

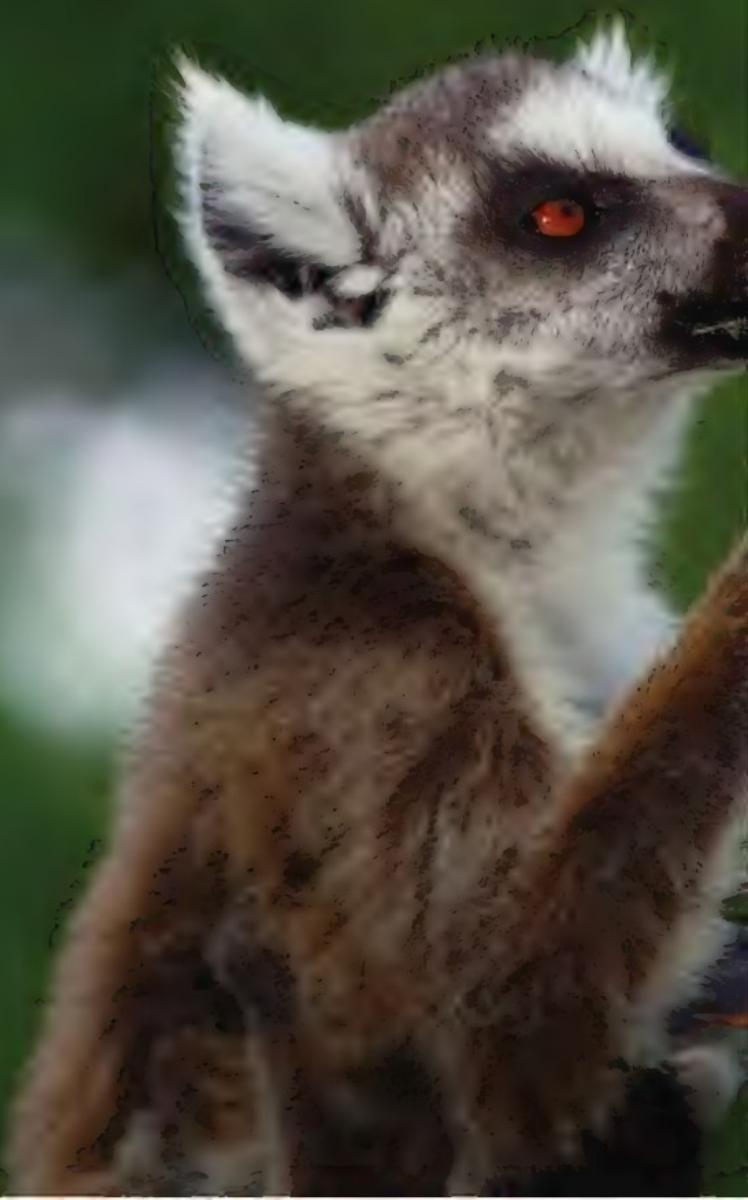
PHELSUMA ORNATA ON GASTONIA
MAURITIANA, MAURITIUS





A Madagascar ring-tailed lemur,
here gnawing a non-native cactus,
ably carries pollen for native
plants on its muzzle and hands.

LEMUR CATTA ON CEREUS HILDMANNIANUS,
MADAGASCAR









This cast of pollinators gets mixed reviews for reliability. In Arizona a *Manduca* hawk moth swoops in to probe an angel's trumpet (left). The pair co-evolved, so their pollinating parts are a perfect fit, and the night feeder can see the flower in the dark. In Hawaii a non-native bird called a Japanese white-eye (above) robs nectar from the base of a *haha'aiakamanu*. In this case the bird sidesteps the pollen, doing the plant no service at all.

Cross-pollination isn't ensured when an ant picks up pollen off a pimaica plant. The ant may then crawl to the ground or another species.

FOREST AND RAIN FOREST OF SOUTHERN ARIZONA





A wild *Heliconius* loads up on pollen at a hot-lips blossom. Most butterflies only sip nectar, but this one has evolved with special equipment—a snout that allows it to mine and then digest pollen. Amino acids in the pollen extend the animal's life, giving it extra weeks to breed.

HELICONIUS ERATO ON *PSYCHOTRIA POEPPIGIANA*, PANAMA





Circling Alaska in 176 Days

Nobody had ever done it before:
Hike, ski, and raft 4,679 miles
through eight national parks,
dozens of mountain ranges, and
the length of the Yukon territory.
Then along came Andrew Skurka.



DENALI NATIONAL PARK, APRIL 27, 2010

"Skiing over this unnamed pass made me nervous," says extreme trekker Andrew Skurka. "I was worrying about an avalanche due to the warm and sunny spring weather." With 1,120 miles behind him, he still had 3,559 to go.



DAYS WITH DRY FEET WHILE HIKING OR RAFTING: 20 OUT OF 21
LONGEST DISTANCE WITHOUT SEEING A ROAD: 657 MILES
LONGEST TIME WITHOUT SEEING ANOTHER HUMAN BEING: 21



DAYS



DILLINGER RIVER, APRIL 17

"Despite my best efforts, my leather ski boots got soaked by the melting snow," says Skurka, who tried to leap across some creeks and rivers.





DILLINGER RIVER, APRIL 17

"Sleep deprived, mentally spent, beat up by a blizzard, and about to start an arduous detour, I couldn't keep my game face," Skurka says of unexpected tears.





WONDER LAKE, APRIL 24

"My diet might look monotonous," Skurka says of his carefully weighed bags of chips, chocolate, and jerky. "But in the wilderness, hunger is the best seasoning."





ALATNA RIVER VALLEY, AUGUST 19

"I paddled across this deep, slow-moving river in my small pack raft," Skurka says. On the other side, he built a big sandbar fire to warm up and cook dinner.

**CLOSEST BEAR ENCOUNTER: ABOUT TEN YARDS
STRATEGY: THREW HIKING POLE AT BEAR, WHICH FLED
MOST MOSQUITOES SMITTEN WITH A SINGLE SLAP: 14**





ARRIGETCH PEAKS, AUGUST 23

"These teeter-tottering granite boulders all wanted to slide," Skurka says of a talus-covered pass in the central Brooks Range, where his friend Roman Dial joined him.





COPPER RIVER, MAY 26

"The ice lingering on Miles Lake was too soft to walk on and too hard to paddle through," says Skurka, who scooted across in his one-person inflatable pack raft.



Zeb Hogan plunges fully clothed into India's Ramganga River to help a goonch catfish swim away after it was caught and tagged.





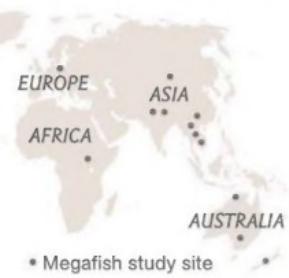
WORLDWIDE

Wrangling Megafish

The world's largest freshwater fish are in trouble. Biologist Zeb Hogan is identifying and protecting as many as he can—before they vanish forever.

I've loved water ever since I was little. I grew up in Arizona, where you learn how precious it is. I get into the water a lot for my work. I'm not always as careful as I should be about the water I get into—dirty, shallow, or deep—as long as there is a big fish in it.

As a conservation biologist, I study these fish. I call them megafish. They're more than six feet long and 200-plus pounds, and they're typically *(Continued)*



■ **Society Project** Zeb Hogan's research is funded in part by your National Geographic Society membership.

FLASHBACK

Trunk Rocker "Such a swing would thrill the most blasé," claimed the caption for this photograph—which left the swinger unidentified—from "The Land of Sawdust and Spangles," the story on circuses published in the October 1931 *National Geographic*. Author Francis Beverly Kelley did not take such performances lightly. "There's no such thing as a tamed wild animal," he wrote. "You can train them, but you never can be certain that they are tamed. Trainers who have trusted their jungle charges too far have been left behind in a horizontal position while the long show trains thundered away to the next town." —Margaret G. Zackowitz



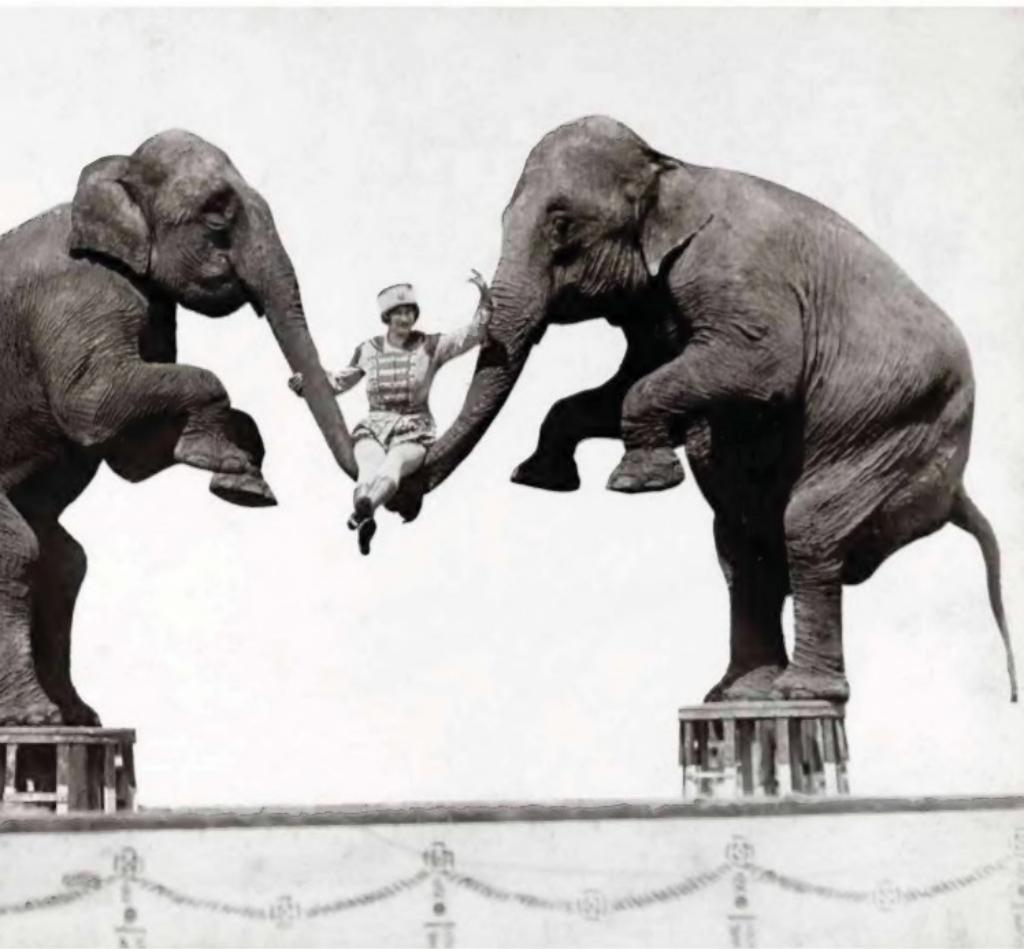


PHOTO: H. A. ATWELL STUDIO/NATIONAL GEOGRAPHIC STOCK